OCT 30 2001

ENGINEERING DATA TRANSMITTAL

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		12. Major Assm. Dwg. No.: N/A
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1	RPP-9125	N/A	0	Evaluation of Sodium Nitrite Addition with Tank 241-AY-102 Waste	E	2	1	1

16. KEY

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(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
		Design Authority									
		Design Agent									
2	1	Cog. Eng. J. A. Lechelt	JLechelt	10/19/01	R2-11	1	1	DST Engr-T.M. Blaak	[illegible]	10/25/01	S5-13
2	1	Cog. Mgr. M. A. Knight	MAKnight	10/26/01	R2-11						
		QA									
		Safety									
2	1	Env. C. H. Mulkey	for PPowell	10/09/01	R1-51						

18.	19.	20.	21. DOE APPROVAL (if required)
JLechelt J. A. Lechelt 10/19/01 Signature of EDT Originator / Date	N/A Authorized Representative for Receiving Organization / Date	MAKnight M. A. Knight 10/29/01 Design Authority/ Cognizant Manager / Date	Ctrl No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments

BD-7400-172-2 (10/97)

BD-7400-172-1

DISTRIBUTION SHEET

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Distribution	Process Control	Page 1 of 1
Project Title/Work Order		Date 10/19/01
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Evaluation of Sodium Nitrite Addition with Tank 241-AY-102 Waste

J. A. Lechelt
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U.S. Department of Energy Contract DE-AC27-99RL14047

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10/29/01

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RPP-9125
Rev. 0

EVALUATION OF SODIUM NITRITE ADDITION WITH TANK 241-AY-102 WASTE

J. A. Lechelt
CH2M HILL Hanford Group, Inc.

Date Published
October 2001

CH2MHILL
Hanford Group, Inc.

Prepared for the U.S. Department of Energy
Office of River Protection

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Checklist For Independent Review

Document: Evaluation of Sodium Nitrite Addition With Tank 241-AY-102 Waste

Yes	No	NA	
[x]	[ ]	[ ]	Problem completely defined.
[x]	[ ]	[ ]	Necessary assumptions explicitly stated and supported.
[ ]	[ ]	[x]	Computer codes and data files documented.
[x]	[ ]	[ ]	Data used in calculations explicitly stated in document.
[x]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
[x]	[ ]	[ ]	Mathematical derivations checked including dimensional consistency of results.
[ ]	[ ]	[x]	Models appropriate and used within range of validity or use outside range of established validity justified.
[x]	[ ]	[ ]	Hand calculations checked for errors.
[ ]	[ ]	[x]	Code run streams correct and consistent with analysis documentation.
[ ]	[ ]	[x]	Code output consistent with input and with results reported in analysis documentation.
[x]	[ ]	[ ]	Acceptability limits on analytical results applicable and supported limits check against sources.
[x]	[ ]	[ ]	Safety margins consistent with good engineering practices.
[x]	[ ]	[ ]	Conclusions consistent with analytical results and applicable limits.
[x]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.

LAFort
Reviewer L. A. Fort

10/24/01
Date

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APPENDICES

LIST OF ACRYONYMS

AC	Administrative Control
AWF	Aging Waste Facility
Bq	Becquerel
Btu/hr	British thermal units per hour
Ci/L	curies per liter
CSR	Criticality Safety Representative
DCRT	double-contained receiver tank
DCRVR	Dilute Receiver Tank
DN	Dilute Non-Complexed Waste
DST	Double-shell tank
g/L	grams per liter
kgal	kilogallon
kL	kiloliter
L	liter
LFL	lower flammability limit
M	molar (moles per liter)
mol	mole
NA	not applicable
NCS	Nuclear Criticality Safety
ORP	U.S. Department of Energy, Office of River Protection
PCB	polychlorinated biphenyl
pH	Potential of hydrogen
ppm	parts per million
SpG	specific gravity
SST	single-shell tank
TFRG	Total Fraction of Risk Guide
TIC	total inorganic carbon
TOC	total organic carbon
TRU	transuranic
TSR	Technical Safety Requirement
ULD	unit liter dose
WCA	waste compatibility assessment
WCT	worst case transfer
WIC	Waste Inventory Control (Group)
WSPS	Waste Stream Profile Sheet
wt %	weight percent
%	percent
°C	degrees Celsius
°F	degrees Fahrenheit

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1.0 INTRODUCTION

Analyses of waste samples taken from tank 241-AY-102 indicate the tank interstitial liquid is deficient in nitrite in accordance with corrosion prevention chemistry. The supernatant was within specifications. Corrosion control is a Technical Safety Requirement (TSR) level control implemented in HNF-IP-1266 (CHG 2001b), Administrative Control (AC) 5.15, "Chemistry Control Program." Sodium hydroxide (caustic) solution was added to the tank in early 2001 to bring it into specification for hydroxide. Sodium nitrite solution will be added to the tank to bring the interstitial liquid into specification for nitrite.

1.1 Objective

The *Tank Farm Waste Transfer Compatibility Program*, HNF-SD-WM-OCD-015 (Fowler 2001), describes the decision rules relating to waste transfers both into and within the Hanford Site Double-Shell Tank (DST) Farm System. The addition of process chemicals and water are exempted from completion of a waste compatibility assessment. However, to ensure that the tank will remain within appropriate Administrative Controls Implementation, Safety, and Operational limits after the sodium nitrite addition, a comparison to established criterion must be made.

1.2 Sodium Nitrite Addition (Source Chemical)

A volume of 64,000 gallons (gal) of 8 molar (M) sodium nitrite ($NaNO_2$) solution will be added to tank 241-AY-102 to bring the interstitial liquid above the lower corrosion control limits. The 8 M sodium nitrite solution is approximately 40 weight percent (wt %) and has a pH of 8.9.

1.3 241-AY-102 (Receiver Tank)

Tank 241-AY-102 is an aging waste facility (AWF) tank and is designated a dilute receiver tank (DCRVR). Tanks 241-AY-101 and 241-AY-102 comprise the 241 AY tank farm. These tanks were put into service in the early 1970s and can hold up to 1,000,000 gallons each. The AWF tanks are designed to withstand high heat loads.

Tank 241-AY-102 contains dilute non-complexed waste (DN). Tank 241-C-106, a single-shell tank that was a high heat Watchlist tank, was retrieved into tank 241-AY-102 several years ago. Since that time, the waste chemistry in tank 241-AY-102 has changed. Hydroxide and nitrite in some samples have dropped below concentrations necessary to ensure the tank is within corrosion specification limits.

In February 2001, caustic solution was added to tank 241-AY-102 to bring it into compliance with waste chemistry specifications for hydroxide. On February 16, 2001 (following the addition of caustic to the tank), the waste elevation in tank 241-AY-102 was approximately 235 inches (PCSACS), equivalent to 646,250 gallons of waste. No waste has been added since the caustic addition. The volume of waste in the tank includes including approximately 462,250 gallons of supernate and 184,000 gallons (66.9 inches) of solids (Hanlon 2001). The addition of 64,000 gallons of nitrite solution into tank 241-AY-102, along with approximately 5,000 gallons of process and flush water, will ensure the tank is within specification for nitrite. This volume of chemical and water additions will fill the tank to approximately 260 inches.

2.0 RESULTS AND CONCLUSIONS

The addition of sodium nitrite solution to tank 241-AY-102 was compared to the Administrative Controls Implementation, Safety, and applicable Operational Criteria used in the compatibility program (Fowler 2001), along with another criterion applicable specifically to chemical additions. The initial and final contents of tank 241-AY-102 were compared to the criteria, along with that of the planned chemical addition. No criteria were exceeded which may have precluded the addition of sodium nitrite solution to the tank. Appendix A provides a disposition of each of the applicable criterion. Appendix B gives calculation details to support the determinations.

Process Control recommends the addition of up to 64,000 gallons of 8 M sodium nitrite solution and up to 5,000 gallons of raw water for process needs, to tank 241-AY-102. The recommendation for the additions of sodium nitrite solution and water is conditional on meeting all the requirements in Section 3.0.

Process Control has also reviewed water usage for operational needs in tank 241-AY-102. Upper bounds on the amount of water that can be added to the tank have been established. The upper bounds ensure the tank will not exceed specifications for corrosion control and time to reach 25 percent of the lower flammability limit (LFL) for hydrogen. Several water addition scenarios are given below.

- Prior to the addition of sodium nitrite solution and up to the first 15,000 gallons of sodium nitrite added to tank 241-AY-102, water additions are limited to that specified in *Pre-Evaluated Limits for DST and AWF Tank Water Additions*, latest revision (located on \\AP005\PLUTINV, in the folder: DST HGR Baseline, with the file name: DST Water Addition Limits.pdf).

- After the first 15,000 gallons of sodium nitrite solution has been added to tank 241-AY-102, the volume of water added to the tank cannot exceed 25 percent of the volume of sodium nitrite added to the tank, up to 5,000 gallons of water. The limit of 5,000 gallons of water is specified as a reasonable water usage limit for this addition.

- If water addition greater than 5,000 gallons is required, Process Control should be requested to prior provide written documentation stating that the addition of more water is acceptable when compared to corrosion control and time to LFL criteria.

- Following the conclusion of the sodium nitrite solution addition and any associated water flushes to tank 241-AY-102, Process Control will reevaluate the water addition limit in the tank and update the *Pre-Evaluated Limits for DST and AWF Tank Water Additions*.

3.0 REQUIREMENTS

The recommendation for allowing the addition of sodium nitrite solution to tank 241-AY-102 is contingent upon remaining within the following requirements. Any deviations require an approved change to this document prior to continuation with the planned addition.

1) Written approval must be obtained from the Department of Energy – Office of River Protection prior to adding sodium nitrite solution to tank 241-AY-102.

2) The tank 241-AY-102 volume, following the chemical and flush/process water additions, was evaluated to a level of no more than 260 inches in the tank, the limit of this evaluation. The tank level may not exceed that limit without a prior written evaluation by Process Control.

3) The chemical addition to tank 241-AY-102 was evaluated for a maximum volume of 64,000 gallons of approximately 8 M sodium nitrite solution, the limit of this evaluation. The volume of sodium nitrite added to the tank may not exceed that limit without a prior written evaluation by Process Control. A smaller volume of sodium nitrite may be added.

4) Water additions to tank 241-AY-102 should be minimized as much as is practical. Several water addition scenarios were evaluated in order to place upper bound limits for water additions. These scenarios are described in Section 2.0 of this document. After the addition of 15,000 gallons of sodium nitrite to the tank, the limit for water additions is 5,000 gallons.

5) Prior to adding sodium nitrite solution to tank 241-AY-102, each batch must be verified, by review of sample analyses, to have a pH of greater than or equal to 8 ($pH \geq 8$).

6) The authorization for acceptance of sodium nitrite solution in tank 241-AY-102 shall expire after the nitrite solution addition and all associated line flushes are completed or on October 18, 2002, whichever occurs first.

4.0 METHOD OF ANALYSIS

HNF-IP-1266, Section 5.12, "Transfer Controls," (CHG 2001a) requires that prior to acceptance of a waste transfer, the proposed transfer shall be evaluated as specified in HNF-SD-WM-OCD-015 (Fowler 2001). The evaluation is necessary to ensure that the sending and receiving tanks will still meet the controls of criticality, tank bumps, flammable gas deflagrations, organic solvent fires, organic salt-nitrate reaction, and moisture after the transfer.

Although chemical additions are exempt from the requirement of a waste compatibility assessment, this evaluation will compare compositions of the proposed chemical addition with the waste in the receiver tank, 241-AY-102, and evaluate pertinent pre-addition and post-addition conditions. The format of this evaluation is taken from the HNF-SD-WM-OCD-015, Waste Compatibility Compliance Table. Sections for Administrative Controls Implementation, Safety, and Operational Criteria are used. In addition, an Administrative Controls Implementation criterion specifically for the pH of chemical additions is included. The table is retitled to indicate that it is for chemical compatibility compliance.

The final weighted average concentration for each constituent is calculated to determine the composition of the waste in the tank following the addition of the sodium nitrite solution. Other calculations are completed in a similar manner to determine final conditions in the tank. The results are compared to the appropriate compatibility program criteria. The calculation methods used to determine compliance with the waste transfer decision criteria are outlined in a spreadsheet found in Appendix B. All calculations are independently checked, with acknowledgement of that action by signature or initials on each calculation page.

5.0 INPUT DATA

5.1 Assumptions

To ensure the waste in a tank is bounded, the worst-case concentrations of constituents are used. Minimum values are used for nitrite and hydroxide as the worst-case for corrosion control purposes. The minimum specific gravity (SpG) is used for the calculation of transuranics; the maximum SpG is used for other purposes. The average sodium concentration is used at the request of the customer. The maximum analytical value was used for all other constituents to provide the worst-case conditions.

The following assumptions were made which are specific to this sodium nitrite solution addition to tank 241-AY-102.

- The addition of sodium nitrite solution to tank 241-AY-102 will not significantly increase the solids volume in the tank.

- The maximum dome and waste temperatures in tank 241-AY-102 over the past year were used as the expected maximum temperatures in the tank. These values are used in calculating the time to reach 25% of the lower flammability limit for hydrogen in the tank dome space, assuming active ventilation is lost.

- The evaluation considers only the final concentrations for aqueous phase waste in the tank.

5.2 Sodium Nitrite Solution

The nitrite that will be added to tank 241-AY-102 is 8 M or approximately 40 wt %. The concentrations of sodium and nitrite are determined using the known molecular weights of sodium and nitrite. The specific gravity of 40 wt % sodium nitrite solution was obtained from Material Safety Data Sheet (MSDS) (MSDS #058675). The data used in the evaluation are found in Appendix B.

5.3 Tank 241-AY-102 Waste

Core samples and grab samples were taken from tank 241-AY-102 concurrently in April/May 2001, following the addition of caustic to the tank in February 2001. The analyses data are available from the Tank Waste Information Network System (TWINS) database. Details of the data used in the evaluation are found in Appendix B.

6.0 REFERENCES

CHG, 2001a, *Tank Farm Operations Administrative Controls*, HNF-IP-1266, Rev. 3, Administrative Control (AC) 5.12, "Transfer Controls," CH2M HILL Hanford Group, Inc., Richland, Washington.

CHG, 2001b, *Tank Farm Operations Administrative Controls*, HNF-IP-1266, Revision 2B, AC 5.15, "Chemistry Control Program," CH2M HILL Hanford Group, Inc., Richland, Washington.

Conner, J. M., 2001, *Calculation of Sodium Nitrate Volume to be Added to Tank 241-AY-102*, RPP-9114, Revision 0 (draft), CH2M HILL Hanford Group, Inc., Richland, Washington.

Fowler, K. D., 2001, *Tank Farm Waste Compatibility Program*, HNF-SD-WM-OCD-015, Rev. 4, CH2M HILL Hanford Group, Inc., Richland, Washington.

Hanlon, B. M., 2001, *Waste Tank Summary Report for Month Ending July 31, 2001*, HNF-EP-0182, Rev. 160, CH2M HILL Hanford Group, Inc., Richland, Washington.

Mulkey, C. H., 2001, *Management of the Polychlorinated Biphenyl Inventory in the Double-Shell Tank System*, RPP-6623, Rev. 2, CH2M HILL Hanford Group, Inc., Richland, Washington

MSDS (Material Safety Data Sheet), Sodium Nitrite Solution, #058675, Revised January 1999, Repauno Products, LLC, Gibbstown, New Jersey.

Pre-Evaluated Limits for DST and AWF Tank Water Additions, Revised 9/17/01, \\AP005\PLUTINV, folder: DST HGR Baseline, file name: DST Water Addition Limits.pdf

Surveillance Analysis Computer System, (PCSACS), Queried 09/26/01, [Tank 241-AY-102 surface level and temperatures for previous one year], SACSPROD database, also available at http://twins.pnl.gov:8001.

Tank Waste Information Network System (TWINS), Queried 09/26/01, [Tank 241-AY-102 sample data for 2000 and 2001 samples], http://twins.pnl.gov:8001.

APPENDIX A

CHEMICAL ADDITION COMPLIANCE TABLE

SODIUM HYDROXIDE ADDITION WITH TANK 241-AY-102 WASTE

Originator: J. A. Lechelt JAL
Date: 10/25/01

Checker: L. A. Fort LAF
Date: 10/24/01

Chemical Addition Compliance Table
Sodium Hydroxide Addition with Tank 241-AY-102 Waste

CRITERIA	PROGRAM REQUIREMENT	COMPLIANCE STATUS
ADMINISTRATIVE CONTROLS IMPLEMENTATION CRITERIA		
Criticality (Pu = plutonium equivalent) (Evaluate non-TF source pre-transfer)	Uranium enrichment ≤ 1.03 and pH ≥ 8 Pu < 0.001 g/l, or 0.001 g/l < Pu ≤ 0.04 g/l, pH ≥ 8, and at least one X/Pu > the corresponding ratio in HNF-SD-WM-OCD-015, Table 2-1 242-A Evaporator feed Pu ≤ 0.005 g/l If Pu content > 50g in a single batch, sum of component subcritical mass fractions ≥ 2	NA – See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 2.1): Water and chemical additions are exempted from this criterion.		
Radiological Source Term Controls – DST Liquids (Evaluate non-TF source pre-transfer)	Non-tank farm facility waste: Total OnSite and OffSite ULD ≤ limit in HNF-SD-WM-OCD-015, Table 2-2.	NA – See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 2.2.1): Water and chemical additions are exempted from this criterion.		
Radiological Source Term Controls – DST Solids (Evaluate non-TF source pre-transfer)	Non-tank farm facility waste: Total OnSite and OffSite ULD ≤ limit in HNF-SD-WM-OCD-015, Table 2-3.	NA – See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 2.2.2): Water and chemical additions are exempted from this criterion.		
Toxic Chemical Source Term Controls (Evaluate non-TF source pre-transfer)	Non-tank farm facility waste: NH_3^+ < 4.78% of Total Fraction of Risk Guide (TFRG), NaOH < 32.44% of TFRG, Na^+ < 54.07% of TFRG, TOC – Oxalate < 4.05% of TFRG, U < 3.33% of TFRG. If one parameter exceeds specified TFRG %, then total of TFRGs must be < 98.67%	NA – See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 2.2.3): Water and chemical additions are exempted from this criterion.		
Bulk Chemical Runaway Reaction (Evaluate receiver post-transfer)	Receiving tank end state heat load < 74,000 Btu/hr <u>and</u> TOC < 52 g/l (3.8 wt%) OR If further evaluation per method in HNF-3588 determines that a bulk chemical runaway is not possible	See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 2.3): Tank 241-AY-102 has a final heat load of 235,912 Btu/hr (based on ^{137}Cs and ^{90}Sr concentrations), but the TOC = 1.91 g/L. Therefore, further evaluation is not required.		
Tank Time to LFL Determination (Evaluate receiver post-transfer)	DST and AWF: minimum time to reach 25% of LFL for tank vapor space will remain > 7 days, assuming loss of primary tank ventilation.	In Compliance
Disposition (HNF-SD-WM-OCD-015, Section 2.4): Tank 241-AY-102 after the waste/water additions will reach 25% of the LFL in 28 days, assuming loss of primary ventilation.		

Originator: J. A. Lechelt JL Date: 10/25/01 | Checker: L. A. Fort LAF Date: 10/24/01

Chemical Addition Compliance Table Sodium Hydroxide Addition with Tank 241-AY-102 Waste		
CRITERIA	**PROGRAM REQUIREMENT**	**COMPLIANCE STATUS**
DST Waste Chemistry (Evaluate source and receiver post-transfer)	$[NO_3^-] < 1M$, $0.01M \leq [OH^-] \leq 8M$, $0.011 \leq [NO_2^-] \leq 5.5M$, $[NO_3^-]/([OH^-] + [NO_2^-]) < 2.5$; If $0.01M < [OH^-] < 0.015M$ and/or $0.011M < [NO_2^-] < 0.015M$, then check RSD. $1.0 < [NO_3^-] \leq 3.0M$, $0.1 \times [NO_3^-] \leq [OH^-] < 10M$, $[OH^-] + [NO_2^-] \geq 0.4 \times [NO_3^-]$ $[NO_3^-] > 3.0M$, $0.3M \leq [OH^-]$ 10M, $[OH^-] + [NO_2^-] \geq 1.2M$, $[NO_3^-] \leq 5.5M$	See Disposition

Disposition (HNF-SD-WM-OCD-015, Section 2.5): Sample data indicates tank 241-AY-102 is out of compliance with tank chemistry controls, which is the reason the sodium nitrite solution is being added to the tank. The worst-case analytical data was used to make the following determinations.

Tank 241-AY-102 interstitial liquid before addition: $[NO_3^-] = 0.01$ M; $[OH^-] = 0.01$ M; $[NO_2^-] = 0.005$ M. $[NO_3^-]/([OH^-] + [NO_2^-]) = 0.01/(0.01 + 0.005) = 0.44$, which is < 2.5. $[NO_2^-] = 0.005$ $\underline{M} < 0.011$ $\underline{M}$ (out of compliance)

Tank 241-AY-102 interstitial liquid after addition: $[NO_3^-] = 0.01$ M; $[OH^-] = 0.01$ M; $[NO_2^-] = 0.97$ M. $[NO_3^-]/([OH^-] + [NO_2^-]) = 0.01/(0.01 + 0.97) = 0.01$, which is < 2.5 (in compliance)

Chemical Addition pH **Note: This criterion was added to the table. The criterion is specific to chemical additions as required by AC 5.12.**	Chemical additions must have pH $\geq$ 8.	See Disposition

Disposition: The MSDS for 40 wt% sodium nitrite solution states that the pH is 8.9. Each batch of sodium nitrite is required to demonstrate by sample analysis, that the pH $\geq$ 8 (Section 3.0, Requirement 5).

SAFETY CRITERIA

Flammable Gas (Evaluate receiver post-transfer)	(Solids depth (in.) x convective SpG) < 148 If source waste SpG > 1.41, receiver tank average SpG $\leq$ 1.41 after transfer	In Compliance

Disposition (HNF-SD-WM-OCD-015, Section 3.1): Tank 241-AY-102 has an initial and final solids depth of 66.9 inches, an initial convective SpG of 1.17 (66.9 x 1.17 = 78) and a final convective SpG of 1.18 (66.9 x 1.18 = 79). The 8 $\underline{M}$ sodium nitrite SpG = 1.32.

Organic and Energetic Reaction (Evaluate source pre-transfer)	Source Exotherm/Endotherm < 1.0; No separable organic layer *Maximum Exotherm = 480 joules/gram* If free water < 20%, TOC (dry) < 4.5 + 0.17 (wt% free water)	In Compliance

Disposition (HNF-SD-WM-OCD-015, Section 3.2): Tank 241-AY-102 does not have exotherms in excess of endotherms; no separable organic layer has been found. Further analysis is not required.

Originator: J. A. Lechelt
Date: 10/26/01

Checker: L. A. Fort
Date: 10/26/01

Chemical Addition Compliance Table Sodium Hydroxide Addition with Tank 241-AY-102 Waste		
CRITERIA	**PROGRAM REQUIREMENT**	**COMPLIANCE STATUS**
DCRT Corrosion Control (Evaluate receiver post-transfer)	$[NO_3^-] \leq 1M$, $0.01M \leq [OH^-] < 8M$, $0.011 \leq [NO_2^-] \leq 5.5M$, If $0.01M < [OH^-] < 0.015M$ and/or $0.011M < [NO_2^-] < 0.015M$, then check RSD. $1.0 < [NO_3^-] \leq 3.0M$, $0.1 \times [NO_3^-] \leq [OH^-] < 10M$, $[OH^-] + [NO_2^-] \geq 0.4 \times [NO_3^-]$ $[NO_3^-] > 3.0M$, $0.3M \leq [OH^-]$ 10M, $[OH^-] + [NO_2^-] \geq 1.2M$, $[NO_3^-] \leq 5.5M$	NA – See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 3.3): Tank 241-AY-102 is not DCRT nor will a DCRT be involved in this addition.		
REGULATORY CRITERA		
Current WSPS (Evaluate source pre-transfer)	Source Waste from outside the DST System must have a current WSPS on file. New/Revised WSPS reviewed by CSR/Alternate (Non-Tank Farms facility waste streams only)	NA – See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 4.1.1): Water and chemical additions are exempted from this criterion, which applies only to source waste from outside the DST system.		
Chemical Compatibility (Evaluate source and receiver pre-transfer)	Identify potential hazards for mixing wastes in specific reactivity groups (HNF-SD-WM-OCD-015, Fig. 4-1)	
Disposition (HNF-SD-WM-OCD-015, Section 4.1.3): Tank 241-AY-102 has the following reactivity groups: 106 – Water and Mixtures Containing Water and 10 – Caustics. The sodium nitrite solution has the following reactivity groups: 10 – Caustics. No potential hazard has been identified for mixing of the reactivity groups.		
PCB Management (Evaluate source pre-transfer and receiver post-transfer)	If any PCB detected: non-TF waste must be designated as PCB Remediation, Analytical or R&D (see definition requirements in HNF-SD-WM-OCD-015, Section 4.1.4.1) Separate phase analysis required if ≥ 0.5 wt % solids in non-TF source. Non-TF source [PCB]: solids ≤ 450 ppm (dry wt. basis) and liquid ≤ 2.9 ppm Receiver [PCB] must remain: ≤ 50 ppm in solids and ≤ 2.9 ppm in liquid	See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 4.1.4): The addition of sodium nitrite to tank 241-AY-102 will not add PCBs to the tank, but does increase the volume in the tank, diluting the liquid concentration of PCBs. The tank was baselined using the default values for PCBs, since data are not available. The tank 241-AY-102 liquid PCB concentration after the waste addition is 0.52 ppm and the solid PCB concentration is 25 ppm.		
PROGRAMMATIC CRITERIA		
Configuration Control (Evaluate source and receiver pre-transfer)	Maintain transfers consistent with restrictions given in Table 5-1.	See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 5.1): Tank 241-AY-102 is under configuration control and the addition of sodium nitrite requires ORP approval. The first requirement of Section 3.0 is that ORP approval is required before the sodium nitrite can be added to the tank.		

Originator: J. A. Lechelt JAL Checker: L. A. Fort LAF
Date: 10/26/01 Date: 10/26/01

Chemical Addition Compliance Table Sodium Hydroxide Addition with Tank 241-AY-102 Waste		
CRITERIA	**PROGRAM REQUIREMENT**	**COMPLIANCE STATUS**
Waste Feed Envelope (Evaluate source pre-transfer and receiver post-transfer)	Envelope A: < 0.5 moles of organic carbon per mole of sodium; < 4.4E+07 Becquerels (Bq) Sr^{90} per mole sodium; < 4.8E+05 Bq TRU per mole sodium; Complexed concentrate (CC) stored with other CC waste.	See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 5.2): The source is sodium nitrite solution and does not contain any of the analytes of interest except sodium (8 M). Tank 241-AY-102 initial: mol TOC/mol Na = 0.071; Bq Sr90/mol Na = 1.03E+07; Bq TRU/mol Na = 1.58E+06 (out of compliance) Tank 241-AY-102 final: mol TOC/mol Na = 0.05; Bq Sr90/mol Na = 7.18E+06; Bq TRU/mol Na = 1.10E+06 (out of compliance) The tank is out of compliance before and after the chemical addition. No further action is required. Tank 241-AY-102 is not a CC tank (it is DN).		
WIC Group Approval	All waste transfers require WIC Group approval.	In Compliance
Disposition (HNF-SD-WM-OCD-015, Section 5.3): WIC Group approval for the addition of sodium nitrite solution to tank 241-AY-102 was received by email on October 24, 2001.		
OPERATIONAL CRITERA		
Heat Generation Rate (Evaluate receiver post-transfer)	AN, AP & AW tanks < 70,000 Btu/hr; SY tanks < 50,000 Btu/hr; AY & AZ tanks ≤ 4,000,000 Btu/hr.	In Compliance
Disposition (HNF-SD-WM-OCD-015, Section 6.1): The calculated heat generation rate for tank 241-AY-102 is 235,912 Btu/hr, which is less than the limit.		
AWF 5 Molar Sodium Rule (Evaluate receiver post-transfer)	Max. $[Na^+]$ = 5.0 M in AWF tanks	In Compliance
Disposition (HNF-SD-WM-OCD-015, Section 6.2): 8 M sodium nitrite will be added to tank 241-AY-102. The final $[Na^+]$ in tank 241-AY-102 is 3.2 M.		
Phosphate Waste (Evaluate source and receiver pre-transfer)	High phosphate waste ($[PO_4^{-3}]$ > 0.1M) not to be mixed with high salt waste ($[Na^+]$ > 8.0M).	In Compliance
Disposition (HNF-SD-WM-OCD-015, Section 6.3): Sodium nitrite contains no phosphate, but does have 8 M sodium concentration. The waste in tank 241-AY-102 is neither a high phosphate (0.06 M) nor high sodium (2.57 M).		
Line Plugging (Evaluate source pre-transfer)	< 5 volume % solids and SpG < 1.35 or evaluation necessary	In Compliance
Disposition (HNF-SD-WM-OCD-015, Section 6.4): The sodium nitrite solution does not contain solids and the SpG is 1.32.		
Waste Segregation (Evaluate source and receiver pre-transfer)	Segregate complexed from non-complexed and from TRU wastes to minimize creation of additional TRU waste and minimize adverse impacts to waste volume reduction	NA – See Disposition
Disposition (HNF-SD-WM-OCD-015, Section 6.5): Water and chemical additions are exempted from this criterion.		

APPENDIX B

CALCULATIONS FOR WASTE COMPATIBILITY DETERMINATION

Originator Name: J. A. Lechelt JAL
Date: 10/24/01

Checker Name: L. A. Fort LAF
Date: 10/24/01

Source Tank/Waste	$NaNO_2$	Units
Liquid Volume	64,000	gal
Liquid SpG (max)	1.32	unitless
Liquid SpG (min)	1.32	unitless
Solids Volume	0	gal
Solids Bulk Density	1	g/mL
Solids % water	0	%
Liquids %water	60	%
Liquids PCB	0	(μg/L)
Solids PCB	0	(μg/kg)
Net Exotherm?Y/N	N	

Constituent	Concentration (μg/mL)	Concentration (g/L)	Concentration (M)	Comments/References
Al	0.00E+00	0.00E+00	0.00E+00	
Cl	0.00E+00	0.00E+00	0.00E+00	
Cr	0.00E+00	0.00E+00	0.00E+00	
Fe	0.00E+00	0.00E+00	0.00E+00	
Mn	0.00E+00	0.00E+00		
Na avg	1.84E+05	1.84E+02	8.00E+00	Planned addition of 8M $NaNO_2$
NaOH	0.00E+00	0.00E+00	0.00E+00	
NH_3	0.00E+00	0.00E+00		
Ni	0.00E+00	0.00E+00	0.00E+00	
NO_2 max	3.68E+05	3.68E+02	8.00E+00	Planned addition of 8M NaNO2
NO_2 min	3.68E+05	3.68E+02	8.00E+00	Planned addition of 8M $NaNO_2$
NO_3 max	0.00E+00	0.00E+00	0.00E+00	
NO_3 min	0.00E+00	0.00E+00	0.00E+00	
OH min	0.00E+00	0.00E+00	0.00E+00	
PO_4	0.00E+00	0.00E+00	0.00E+00	
TOC	0.00E+00	0.00E+00	0.00E+00	
Total U	0.00E+00	0.00E+00	0.00E+00	
U 233	0.00E+00	0.00E+00		
U 235	0.00E+00	0.00E+00		
Isotope (Liquid)	**Concentration (μCi/mL)**	**Concentration (Ci/L)**	**Concentration (g/L)**	
Sr 90	0.00E+00	0.00E+00		
Y 90	0.00E+00	0.00E+00		
Cs 137	0.00E+00	0.00E+00		
Pu 239/40	0.00E+00	0.00E+00	0.00E+00	
Am 241	0.00E+00	0.00E+00	0.00E+00	
Total alpha	0.00E+00	0.00E+00		
Isotope (Solid)	**Concentration (μCi/g)**	**Concentration (μCi/mL)**		
Sr 90	0.00E+00	0.00E+00		
Cs 137	0.00E+00	0.00E+00		
Total alpha	0.00E+00	0.00E+00		

Originator Name: J. A. Lechelt JAL

Date: 10/24/01

Checker Name: L. A. Fort LAF

Date: 10/24/01

Receiver Tank Name	241-AY-102	Units
Liquid Volume	462,250	gal
Liquid SpG (max)	1.168	unitless
Liquid SpG (min)	1.147	unitless
Solids Volume	184,000	gal
Solids Bulk Density	1.44	g/mL
Solids % water	45	%
Liquids %water	87.43	%
Liquids PCB		(µg/L)
Solids PCB		(µg/kg)
Net Exotherm?Y/N	N	
Waste Temperature	158.3	° F
Dome Temperature	109.7	° F
Active Vent Rate	700	cfm

Constituent	Concentration (µg/mL)	Concentration (g/L)	Concentration (M)	Comments/References
Al	3.92E+03	3.92E+00	1.45E-01	Maximum of 2001 samples
Cl	1.92E+02	1.92E-01	5.42E-03	Maximum of 2001 samples
Cr	2.63E+01	2.63E-02	5.06E-04	Maximum of 2001 samples
Fe	1.77E+01	1.77E-02	3.17E-04	Maximum of 2001 samples
Mn	8.53E+00	8.53E-03		Maximum of 2001 samples
Na avg	5.90E+04	5.90E+01	2.57E+00	Average of 2001 sample results
NaOH	0.00E+00	0.00E+00	0.00E+00	No 2001 sample data.
NH_3	0.00E+00	0.00E+00		No 2001 sample data.
Ni	4.02E+00	4.02E-03	6.85E-05	Detection limit; undetected in all samples.
NO_2 max	6.31E+03	6.31E+00	1.37E-01	Maximum of 2001 samples
NO_2 min	2.29E+02	2.29E-01	4.98E-03	Undetected in 2001 interstitial liquid samples.
NO_3 max	4.59E+02	4.59E-01	7.40E-03	Maximum of 2001 samples
NO_3 min	2.94E+02	2.94E-01	4.74E-03	Lowest undetected 2001 sample value
OH min	2.01E+02	2.01E-01	1.18E-02	Lowest detected 2001 sample value (some undetected).
PO_4	5.98E+03	5.98E+00	6.30E-02	Maximum of 2001 samples
TOC	2.19E+03	2.19E+00	1.82E-01	Maximum of 2001 samples
Total U	4.44E+03	4.44E+00	1.87E-02	Maximum of 2001 samples
U 233	2.40E-02	2.40E-05		Detection limit (sample and dup).
U 235	1.35E+02	1.35E-01		Average of 2001 sample results (sample and dup)
Isotope	**Concentration (µCi/mL)**	**Concentration (Ci/L)**	**Concentration (g/L)**	
Sr 90	7.13E-01	7.13E-04		Maximum of 2001 samples
Y 90	7.13E-01	7.13E-04		Assumed to be in equilbrium with Sr
Cs 137	4.95E+01	4.95E-02		Maximum of 2001 samples
Pu 239/40	3.95E-03	3.95E-06	6.37E-05	Maximum of 2000 samples; none for 2001
Am 241	1.06E-01	1.06E-04	3.08E-05	Detection limit (sample and dup).
Total alpha	1.10E-02	1.10E-05		Maximum of 2000 samples; none for 2001
Isotope (Solid)	**Concentration (µCi/g)**	**Concentration (µCi/mL)**		
Sr 90	9920	14284.8		Maximum of 2001 samples
Cs 137	413	594.7		Maximum of 2001 samples

Originator Name: J. A. Lechelt *JAL*
Date: *10/24/01*

Checker Name: L. A. Fort *LAF*
Date: *10/24/01*

Receiver Liquid Contributions	Volume (gal)	Contribution Fraction	SpG	TOC (M)	Al (M)	Na avg (M)	OH min (M)	PO_4 (M)
241-AY-102, Receiver	462,250	0.87	1.02	1.59E-01	1.26E-01	2.23E+00	1.03E-02	5.48E-02
NaNO2, Source	64,000	0.12	0.16			9.64E-01		
Raw Water	5,000	0.01	0.01					
241-AY-102, Receiver Final	531,250	1.00	1.18	1.59E-01	1.26E-01	3.20E+00	1.03E-02	5.48E-02

Receiver Liquid Contributions	NO_3 max (M)	NO_3 min (M)	NO_2 max (M)	NO_2 min (M)	Total U (g/L)	U233 (g/L)	U235 (g/L)
241-AY-102, Receiver	6.44E-03	4.13E-03	1.19E-01	4.33E-03	3.86E+00	2.09E-05	1.17E-01
NaNO2, Source			9.64E-01	9.64E-01			
Raw Water							
241-AY-102, Receiver Final	6.44E-03	4.13E-03	1.08E+00	9.68E-01	3.86E+00	2.09E-05	1.17E-01

Receiver Liquid Contributions	Pu239/240 (g/L)	Am241 (g/L)	Pu239/240 (Ci/L)	Am241 (Ci/L)	Total Alpha (Ci/L)	Pu239/240 (Bq)	Am241 (Bq)	Total Alpha (Bq)
241-AY-102, Receiver	5.54E-05	2.68E-05	3.44E-06	9.20E-05	9.57E-06	1.27E+05	3.40E+06	3.54E+05
NaNO2, Source								
Raw Water								
241-AY-102, Receiver Final	5.54E-05	2.68E-05	3.44E-06	9.20E-05	9.57E-06	1.27E+05	3.40E+06	3.54E+05

Originator Name: J. A. Lechelt JL

Date: 10/24/01

Checker Name: L. A. Fort LAF

Date: 10/24/01

Receiver Liquid Contributions	Cs137 (Ci/L)	Sr90 (Ci/L)	Y90 (Ci/L)	Sr90 (Bq)	mol TOC/ mol Na	Bq Sr/ mol Na	Bq(Pu+Am)/ mol Na	Bq alpha/ mol Na
241-AY-102, Receiver	4.31E-02	6.20E-04	6.20E-04	2.30E+07	0.071	1.03E+07	1.58E+06	1.59E+05
NaNO2, Source								
Raw Water								
241-AY-102, Receiver Final	4.31E-02	6.20E-04	6.20E-04	2.30E+07	0.050	7.18E+06	1.10E+06	1.11E+05

241-AY-102, Receiver Final Heat Load Calculation	Cs Liquid Heat Load (Btu/hr)	Sr Liquid Heat Load (Btu/hr)	Total Liquid Heat Load (Btu/hr)	Cs Solid Heat Load (Btu/hr)	Sr Solid Heat Load (Btu/hr)	Total Solid Heat Load (Btu/hr)	Total Heat Load (Btu/hr)	Total Heat Load (Watts)
241-AY-102, Receiver Final	1.39E+03	2.86E+01	1.42E+03	6.67E+03	2.28E+05	2.34E+05	2.36E+05	6.91E+04

Criticality (Sec. 2.1, Evaluate only Non-Tank Farm Source waste pre-transfer.)

Source Pu equivalents = Pu(Ci/L)/0.062(Ci/g) + U233(g/L) + U235(g/L) = 0.00E+00 g/L

Limit: Must be less than: 0.001 g/L

Note: Other limits apply. See HNF-SD-WM-OCD-015 for non-tank farm source waste limits.

Radiological Source Term Controls, DST Liquids (Sec. 2.2.1, Evaluate only Non-Tank Farm Source waste pre-transfer.)

Source Term Limits for DST Liquids							
DST/SST Liquid Isotope	Concentration µCi/mL	Concentration µCi/L	Concentration (Bq/µCi)	Concentration (Bq/L)	Dose Conversion	Onsite ULD	Offsite ULD
Sr 90	NA	NA	3.70E+04	NA	3.00E-08	NA	NA
Y90	NA	NA	3.70E+04	NA	1.70E-09	NA	NA
Cs137	NA	NA	3.70E+04	NA	6.70E-09	NA	NA
Gross Alpha	NA	NA	3.70E+04	NA	4.50E-05	NA	NA
				Total ULD for Source Waste		0.00E+00	0.00E+00
				Allowable ULD for SST sources		1.44E+03	1.28E+03
Total ULD must be less than or equal to allowable ULD for an DST or SST Source Tank				Allowable ULD for DST sources		7.97E+02	8.45E+02

Originator Name: J. A. Lechelt JAL
Date: 10/24/01

Checker Name: L. A. Fort LAF
Date: 10/24/01

Radiological Source Term Controls, DST Solids (Sec. 2.2.2, Evaluate only Non-Tank Farm Source waste pre-transfer.)

Source Term Limits for DST Solids								
DST/SST Solid Isotope	**Concentration (µCi/g)**	**Density (g/mL)**	**Concentration µCi/mL**	**Concentration µCi/L**	**Concentration (Bq/L)**	**Dose Conversion**	**Onsite ULD (Sv/L)**	**Offsite ULD (Sv/L)**
Sr90	NA	1.00E+00	NA	NA	NA	3.00E-08	NA	NA
Y90	NA	1.00E+00	NA	NA	NA	1.70E-09	NA	NA
Cs137	NA	1.00E+00	NA	NA	NA	6.70E-09	NA	NA
Gross Alpha	NA	1.00E+00	NA	NA	NA	4.50E-05	NA	NA
					Total ULD for Source Waste		0.00E+00	0.00E+00
					Allowable ULD for SST sources		1.06E+04	1.66E+04
Total ULD must be less than or equal to allowable ULD for an DST or SST Source Tank.					Allowable ULD for DST sources		1.07E+05	1.84E+05

Toxic Chemical Source Term Controls (Sec. 2.2.3, Evaluate only Non-Tank Farm Source waste pre-transfer.)

Bounding Limits for 5 Analytes from DST Liquids						
	DST Liquids		Incoming Waste Liquids			
Analyte	**Fraction Risk Guide**	**% Total Fraction Risk Guide**	**Concentration (g/L)**	**Conversion Factor**	**Fraction Risk Guide**	**% Total Fraction Risk Guide**
NH_3	530	4.78	0.00E+00	74.13	0.00E+00	0.00
NaOH	3600	32.44	0.00E+00	17.05	0.00E+00	0.00
Na	6000	54.07	1.84E+02	28.42	5.23E+03	47.10
TOC	450	4.05	0.00E+00	11.37	0.00E+00	0.00
U	370	3.33	0.00E+00	34.1	0.00E+00	0.00
Total	11097	98.67			Total	47.10

Bulk Chemical Runaway Reaction (Sec. 2.3, Evaluate Receiver post-transfer.) Limits, must be less than: (Both results must be exceeded.)

Tank 241-AY-102, Receiver TOC post-transfer	1.91	g/L	52 g/L
Tank 241-AY-102, Receiver heat load post-transfe	**235,912**	Btu/hr	70,000 Btu/hr

Tank Time to LDL Determination (Sec. 2.4, Evaluate Receiver post-transfer.)

Tank 241-AY-102, Receiver post-transfer | 28 | days until 25% of LFL is reached, if active ventilation is lost. Details in this Appendix.

DST Waste Chemistry (Sec. 2.5, Evaluate Receiver pre- and post-transfer. Results on separate sheet.)

Originator Name: J. A. Lechelt JAL
Date: 10/24/01

Checker Name: L. A. Fort LAF
Date: 10/24/01

Flammable Gas (Sec. 3.1, Evaluate Receiver post-transfer.)

	Value	Units	Limits must be less than or equal to:		
Receiver Final Total Waste Volume	715,250	gal	1,144,000	gal	
Receiver Final Total Waste Depth	260.09	in.	416	in.	
Receiver Final Solids Waste Volume	184,000	gal	NA		
Receiver Final Solids Waste Depth	66.91	in.	NA		
Receiver Final Solids Depth (in.) x Convective Sp	79.27	unitless	148		
Receiver Final Convective SpG	1.18	unitless	1.41		
Source Pre-Transfer SpG	1.32	unitless	1.41		If Source pre-transfer SpG is exceeded, the final weighted average SpG
241-AY-102, Receiver Final Weighted Average Sp	1.25	unitless	1.41		must not be exceeded.

Organic Reaction (Sec. 3.2, Evaluate Receiver post-transfer.)

Net Exotherm Reported? No

DCRT Corrosion Control (Sec. 3.3, Evaluate Receiver post- transfer. Results on separate sheet.)

Current WSPS (Sec. 4.1.1, Evaluate non-DST Source pre-transfer. If non-DST source, the WSPS is attached as separate Appendix.)

Chemical Compatibility (Sec. 4.1.3, Evaluate Source and Receiver pre-transfer. Disposition as required.)

PCB Management (Sec. 4.1.4, Evaluate Source pre-transfer and Receiver post-transfer.)

	Source Waste	Receiver Initial	Misc Source 1	Misc Source 2	Misc Source 3	Receiver Final
Tank/Waste/Addition	NaNO2	241-AY-102	0	0	0	241-AY-102
Liquid concentration (ppm)	0.00E+00	*2.90E-01*	0.00E+00	0.00E+00	0.00E+00	2.52E-01
Solid concentration (ppm)	0.00E+00	*2.50E+01*	0.00E+00	0.00E+00	0.00E+00	2.50E+01
Tank liquid inventory (kg)	0.00E+00	5.07E-04	0.00E+00	0.00E+00	0.00E+00	6.01E-01
Tank solid inventory (kg)	0.00E+00	2.51E+01	0.00E+00	0.00E+00	0.00E+00	2.51E+01
Total tank inventory (kg)	0.00E+00	2.51E+01	0.00E+00	0.00E+00	0.00E+00	2.57E+01
Tank liquid inventory (kg dryw	0.00E+00	4.04E-03	0.00E+00	0.00E+00	0.00E+00	4.78E+00
Tank solid inventory (kg drywt	0.00E+00	4.56E+01	0.00E+00	0.00E+00	0.00E+00	4.67E+01
Total tank inventory (kg drywt)	0.00E+00	4.56E+01	0.00E+00	0.00E+00	0.00E+00	5.15E+01

Limits

Liquid concentration ≤:
2.9 ppm

Solid concentration ≤:
450 ppm source
50 ppm receiver

Configuration Control (Sec. 5.1, Evaluate Source and Receiver pre-transfer. Disposition as required.)

Originator Name: J. A. Lechelt
Date: 10/24/01

Checker Name: L. A. Fort
Date: 10/24/01

Feed Envelope A (Sec. 5.2, Evaluate Source pre-transfer and Receiver post-transfer.)

	NaNO2, Source	241-AY-102 befo	241-AY-102 after transfer		Limits must be less than:
mol TOC/mol Na	0.00	0.071	0.050		0.5
Bq Sr90/mol Na	0.00E+00	1.03E+07	7.18E+06		4.40E+07
Bq TRU/mol Na	0.00E+00	**1.58E+06**	**1.10E+06**	Pu + Am	4.80E+05
Bq TRU/mol Na	0.00E+00	1.59E+05	1.11E+05	Total Alpha	4.80E+05

WIC Group Approval (Sec. 5.3, Disposition as required.)

Heat Generation Rate (Sec 6.1, Evaluate Receiver post-transfer.)

Limits specific to tank farm. Must be less than:

Heat generation rate for tank :		Btu/hr	70,000	Btu/hr	AN, AP, and AW Tanks
		Btu/hr	50,000	Btu/hr	SY Tanks
241-AY-102	235,912	Btu/hr	4,000,000	Btu/hr	AY and AZ Tanks

AWF 5 Molar Sodium Rule (Sec. 6.2, Evaluate Receiver post-transfer.)

Limit applies only to AY and AZ tank farms. Must be less than:

241-AY-102	AWF [Na+]	3.20	M	5	M

Phosphate Waste (Sec. 6.3, Evaluate Source and Receiver pre-transfer.)

Limits. High phosphate waste and high sodium waste should not be mixed.

Source $[PO_4^{-3}]$	0.00	M	$[PO_4^{-3}]$	0.1	M
Source $[Na^+]$	8.00	M	$[Na^+]$	8.0	M
Receiver $[PO_4^{-3}]$	0.06	M			
Receiver $[Na^+]$	2.57	M			

Line Plugging (Sec. 6.4, Evaluate Source pre-transfer.)

Limits. Evaluation required if either value is exceeded.

Source solids to be transferred	0.00%	Vol.%	Solids	5%	Vol.%
Source weighted average SpG	1.32	unitless	SpG	1.35	unitless

TRU Segregation (Sec. 6.5, Evaluate Source and Receiver pre-transfer.)

Limit, TRU waste is defined as greater than:

Source TRU (Pu + Am)	0.00	nCi/g	100	nCi/g
Source TRU (Total Alpha)	0.00	nCi/g	100	nCi/g
Receiver TRU (Pu + Am)	95.60	nCi/g	100	nCi/g
Receiver TRU (Total Alpha)	9.59	nCi/g	100	nCi/g

Originator Name: J. A. Lechelt *JAL*
Date: *10/24/01*

Checker Name: L. A. Fort *LAF*
Date: *10/24/01*

Corrosion Control — **241-AY-102, Receiver, Before Transfer (interstitial liquid**

Analyte	Result (µg/mL)	Result (M)	Is [NO_3]...	Is [OH]...	Is [NO_2]...	Is [OH] + [NO_2]... or Corrosion Ratio
NO_3	4.59E+02	0.01	<=1 M?	0.01 M <= [OH] <= 5 M?	0.011 M <= [NO_2] <= 5.5 M	NO_3/(OH + NO_2) < 2.5
OH	2.01E+02	0.01	0.01 <= 1 M	0.01 M <= 0.01 M <= 5 M		0.44 < 2.5
NO_2	2.29E+02	0.005	***Yes***	***Yes***	***NO***	***Yes***
			1 M < [NO_3] <= 3 M?	0.1 M * [NO_3] <= [OH] < 10 M?		>= 0.4 * [NO_3]?
			3 M < [NO_3] <= 5.5 M?	0.3 M <= [OH] < 10 M?		>= 1.2 M?

Corrosion Control — **241-AY-102, Receiver, After Transfer (interstitial liquid**

Analyte	Result (µg/mL)	Result (M)	Is [NO_3]...	Is [OH]...	Is [NO_2]...	Is [OH] + [NO_2]... or Corrosion Ratio
NO_3	3.99E+02	0.01	<=1 M?	0.01 M <= [OH] <= 5 M?	0.011 M <= [NO_2] <= 5.5 M	NO_3/(OH + NO_2) < 2.5
OH	1.75E+02	0.01	0.01 <= 1 M	0.01 M <= 0.01 M <= 5 M	0.011 M <= 0.97 <= 5.5 M	0.01 < 2.5
NO_2	4.45E+04	0.97	***Yes***	***Yes***	***Yes***	***Yes***
			1 M < [NO_3] <= 3 M?	0.1 M * [NO_3] <= [OH] < 10 M?		>= 0.4 * [NO_3]?
			3 M < [NO_3] <= 5.5 M?	0.3 M <= [OH] < 10 M?		>= 1.2 M?

Corrosion Control — **NaNO2, Source Before and After Transfer**

Analyte	Result (µg/mL)	Result (M)	Is [NO_3]...	Is [OH]...	Is [NO_2]...	Is [OH] + [NO_2]... or Corrosion Ratio
NO_3	0.00E+00	0.00	<=1 M?	0.01 M <= [OH] <= 5 M?	0.011 M <= [NO_2] <= 5.5 M	NO_3/(OH + NO_2) < 2.5
OH	0.00E+00	0.00	0 <= 1 M			0 < 2.5
NO_2	3.68E+05	8.00	***Yes***	***NO***	***NO***	***Yes***
			1 M < [NO_3] <= 3 M?	0.1 M * [NO_3] <= [OH] < 10 M?		>= 0.4 * [NO_3]?
			3 M < [NO_3] <= 5.5 M?	0.3 M <= [OH] < 10 M?		>= 1.2 M?

Originator Name: J. A. Lechelt *JAL*
Date: *10/24/01*

Checker Name: L. A. Fort *LAF*
Date: *10/24/01*

Table 1 Hydrogen Generation Rates From Radiolysis Model Calculations

	Hydrogen Generation Rate from Radiolysis Effect										
	Input Data						Calculated Results				
Tank Name	**[TOC] (µg/mL) TOC in Supernate**	**[NO_3] (µg/mL) NO_3 in Supernate**	**[NO_2] (µg/mL) NO_2 in Supernate**	**D_L (g/mL) Density of Supernate**	**T_D (°C) Dome Space Temp.**	**H_L (Watt) Heat Load of Tank**	**[NO_3] M (mol/L) NO_3 in Supernate**	**[NO_2] M (mol/L) NO_2 in Supernate**	**[TOC] (wt%) TOC in Solution**	**G_{H2O} (H_2/100eV) G value for water**	**G_{Rad} (cfm) HGR from Radiolysis**
241-AY-102	1.91E+03	2.56E+02	4.45E+04	1.18	43	6.91E+04	4.13E-03	9.68E-01	1.61E-01	3.10E-02	2.17E-02

Equations

$[NO_3]_M = [NO_3]/C_8*C_9/62$

$[NO_2]_M = [NO_2]/C_8*C_9/46$

$[TOC]_{\%} = [TOC]/D_L/C_8*100$

$G_{H2O} = 0.45 - 0.31 * [NO_2]_M^{1/3} - 0.41 * [NO_3]_M^{1/3}$

(If $G_{H2O} < 0.031$ then $G_{H2O} = 0.031$)

$G_{Rad} = (G_{H2O} + 0.15 *[TOC]_{\%}) * H_L * W_{ev} / C_6 /100*(C_4*(T_d+273)/273)/C_7*C_1$

Input Parameters	**Unit**	**Value**
W_{ev} conversion factor from watt to eV/hr	eV/Wat-hour	2.25E+22
C_1 Conversion Factor from L to ft^3	ft^3/L	0.035144
C_4 Converstion Factor from Mole to Liter	L/mole	22.4
C_5 Conversion Factor from kgallon to Liter	L/kgal	3785.4
C_6 *Avogadro's Number*	*molecules/mol*	6.02E+23
C_7 Conversion Factor from Hour to Minutes	mins/hour	60
C8 Conversion Factor from µg to g	µg/g	1.00E+06
C_9 Converstion Factor from Liter to Mililiter	mL/L	1.00E+03

Originator Name: J. A. Lechelt JAL
Date: 10/24/01

Checker Name: L. A. Fort LAF
Date: 10/24/01

Table 2 Hydrogen Generation Rates from Thermolysis and Corrosion Model Calculations

	Hydrogen Generation Rate from Thermolysis Effect									Hydrogen Generation Rate from Corrosion		
	Input Data						Calculated Results			Input Data	Calculated Results	
Tank Name	[Al] (µg/mL) Aluminate in Supernate	D_S (g/mL) Density of Sludge	V_L (kgal) Volume of Supernate	V_S (kgal) Volume of Sludge	$(H_2O)_S$ (wt%) Water in Sludge	T_W (°C) Tank Waste Temp.	[Al] (wt%) Aluminate in Solution	mL (kg) Total Mass of Liquid	G_{Therm} (cfm) HGR from Thermolysis	D_W (inch) Waste Level	A_{Wet} (ft^2) Wetted Area	G_{Corr} (cfm) HGR from Corrosion
241-AY-102	3.41E+03	1.44	531	184	45.0	70.2	0.288	2.83E+06	7.91E-04	260.09	9525	5.722E-04

Equations

$[Al]_{\%} = [Al]/D_L \cdot 1E\text{-}3$ (D_L from Table 2)

$M_L = (D_L * V_L + D_S * V_S * (H_2O)_S/100) * C_5$

$G_{Therm} = (G_{Therm})_{bl} * (C_4*(T_D+273)/273)*C_1/C_2*M_L*[TOC]/[TOC]_{bl}*[Al]/[Al]_{bl}$

$\quad * \exp(-(Ea)/R * [(1/(T_w+C_3))-(1/Tbl)])$

$A_{Wet} = 3.14159 * ((R_T/2)^2 + R_T * D_w / 12)$

$C_{Corr} = R_{H2} * A_{wet}$

Input Parameters	Unit	Value
R_T Diameter of DST	ft	75
C_3 Converstion Factor from °C to °K	°K	273
C_4 Converstion Factor from Mole to Liter	L/mole	22.4

Input Parameters	Unit	Value
R_{H2} Hydrogen Production Rate (for corrosion)	$ft^3/min/ft^2$	6.007E-08
$[TOC]_{bl}$ TOC concentration of 241-SY-103	wt%	0.74
$[Al]_{bl}$ TOC concentration of 241-SY-103	wt%	2.8
T_{bl} Tank Temperature of 241-SY-103	(°K)	304.7
$(G_{Therm})bl$ Thermolysis HGR of 241-SY-103	mole/kg/day	3.50E-07
$(E_a)_{bl}$ Activation Energy of 241-SY-103	j/mole	91000
R Gas Constant	j/mole-°k	8.3143
C_1 Conversion Factor from L to ft^3	ft^3/L	0.035144
C_2 Conversion Factor from Day to Minutes	mins/day	1440
C_5 Conversion Factor from Gallon to Liter	L/kgal	3785.4

Originator Name: J. A. Lechelt JAL
Date: 10/24/01

Checker Name: L. A. Fort LAF
Date: 10/24/01

Table 3 Total Hydrogen Generation Rate From Model Calculation

	Hydrogen Generation Rate from Radiolysis		**Hydrogen Generation Rate from Thermolysis**		**Hydrogen Generation Rate from Corrosion**		**Total Hydrogen Generation Rate**	
	Calculated Results		Calculated Results		Calculated Results		Calculated Results	
Tank Name	**G_{Rad} (cfm) HGR from Radiolysis**	**(G_{Rad})% HGR % from Radiolysis**	**G_{Therm} (cfm) HGR from Thermolysis**	**(G_{Therm})% HGR % from Thermolysis**	**G_{Corr} (cfm) HGR from Corrosion**	**(G_{Corr})% HGR % from Corrosion**	**G_{Mod} (cfm) Total HGR from *Model***	**G_{Mod} (L/Day) Total HGR from *Model***
241-AY-102	2.17E-02	94.1%	7.91E-04	3.4%	5.722E-04	2.5%	2.309E-02	946

Originator Name: J. A. Lechelt JAL
Date: 10/24/01

Checker Name: L. A. Fort LAF
Date: 10/24/01

Table 4 Evaluation of Tank Headspace Level of Flammability Limit

	Calculation of Hydrogen Concentration in Steady State Using Model Hydrogen Generation Rate				Calculation for the Condition of Lost Active Ventilation Using Barometric Breathing Rate (The $[H_2](t)$ limit is 0.93% at 25% LFL)					
	Input data			Calculated Results	Input Data	Calculated Results				
Tank Name	**V_R (cfm) Measured Active Ventilation Rate**	**G_R (cfm) Hydrogen Generation Rate**	**G_R (cfm) Hydrogen Generation Rate from Model**	**$[H_2]_{SS}$ (ppmv) *Steady State* Hydrogen Concen.**	**V_W *(kgal)* Waste Volume**	**Vol (ft^3) Headspace Volume**	**V_{BB} (cfm) *Barometric* Breathing Rate**	**t (day) Time to Reach 25% LFL**	**$[H_2]_{BB}$ (%) Steady State Hydrogen Concen.**	**$V_R$min (cfm) Minimum Ventilation Rate Not to Exceed 25%**
241-AY-102	7.00E+02	2.309E-02	2.309E-02	33	715	92,876	0.29	28	7.4	2.45

Equations

$[H_2]_{SS} = G_R/(G_R+V_R)$

$Vol = 188490 - V_w * 133.679$

$V_{BB} = 0.45\% * Vol/24/60$

$t = Vol/(G_R+V_{BB}) * LN\{[G_R-(G_R+V_{BB})*0.93\%] / [G_R-(G_R+V_{BB}) * [H_2]_{SS}]\}$

$[H_2]_{BB} = G_R/(G_R+V_{BB})$

$V_R min = G_R * [(1/0.93\%) - 1]$

Input Parameters	**Unit**	**Value**
Barometric Breathing Rate Coefficient	Unitless	0.45%
Hydrogen Concentration at 25% LFL	%	0.93%
Total Volume of DSTs	ft^3	188,490
Conversion factor (from kgal to ft^3)	ft^3/kgal	133.679